

BEST AVAILABLE COPYRemarksObjections to claims

Applicant has amended claims 2, 14 and 24 to provide proper antecedent basis for 'earth model' in claims 3, 15, 25 and 26.

102 Rejection based on Rao

Rao does not teach or suggest identification of the type of "drilling hazard" described and claimed by Applicant. Applicant claims "characterizing a drilling hazard" and defines "drilling hazard" as undesirable occurrences during drilling, giving examples including lost circulation, stuck pipe and taking a kick. (Applicant's specification pages 2 and 8.) This is in contrast to the type of drilling hazard described by Rao as geologic or environmental features that could be detrimental to the drilling performance. (Rao, col. 4:25-31.) Thus, Rao proposes identification of geologic features, such as a hardened strata and formation faults, but does not take the valuable next step to identify a particular drilling occurrence, such as a dangerous or costly drilling operation problem.

The distinction between identifying a detrimental formation characteristic versus identifying a particular problematic drilling operation is important. Applicant's describes this failure of the prior art in its background section, specifically that prior art systems do not have the ability to determine the probability of encountering the drilling hazard (i.e. undesirable drilling operation) for a well plan, the likely severity of consequences and the cost to repair damage. (Applicant's specification, page 4.) Like these prior art systems, Rao also does not provide these capabilities because Rao stops at the identification of a particular formation feature. Rao does not take the extra non-obvious step of translating the effect of encountering the formation feature to an occurrence of a problematic drilling operation (or Applicant's drilling hazard). It is this type of "drilling hazard" Applicant claims and not the drilling hazard defined by Rao to merely be an identification of a formation characteristic, such as a hard strata.

Furthermore, Rao does not teach or suggest Applicant's claimed "likelihood of an occurrence...of at least one drilling hazard," nor "the severity of the at least one drilling hazard." As above, Rao stops at identifying a detrimental formation characteristic in a timely manner so that an operator has formation information to assist in drilling operations decisions. (Rao, col. 5:48-54 and col. 6:16-21.) Although Rao discusses the ability to locate the acoustically sensed

formation data with respect to the well trajectory, this is not tantamount to Applicant's claimed step for determining the likelihood of whether or not a particular drilling problem will occur. As above, a likelihood that a drilling trajectory will intersect a hard formation strata (as in Rao) (Rao, col. 8:10-18 and col. 8:47-59) falls short of Applicant's indication of the likely impact on the drilling operations such an intersection, for example, would cause (i.e. the likelihood of a drilling hazard occurrence). Thus, because Applicant defines its drilling hazard with respect to specific resulting drilling operation problems and because Rao merely identifies detrimental formation characteristics, for example, Rao does not teach or suggest determination of a likelihood that a particular drilling operation problem would occur.

The same is true of Applicant's indication of a "severity." Rao stops far short of determining a consequence, and specifically a severity, of colliding with any specific formation strata. Although Rao discloses that bit change decisions may result from its formation strata identification (Rao, col. 4:35-45), this is not a sufficient teaching for a determination as to the severity of consequences assuming the drilling hazard occurs, nor is it a teaching for a determination as to the likelihood that the drilling hazard occurs. Here again, because Rao only determines the existence of detrimental formation characteristics, i.e. Rao's drilling hazards, and does not perform the additional calculations to determine potentially resultant drilling operation problems, i.e. Applicant's drilling hazards, Rao does not teach the further calculations for likelihood of occurrence or severity of a drilling hazard. Rao does suggest that a display of a magnitude of risk may be made with respect to its drilling hazard. (Rao, col. 9:26-39.) However, in this context Rao defines risk consistent with its definition of hazard, in that its risk is simply an indication of the extent of the formation characteristic, i.e. projected hardness of a formation strata. This type of risk, as above, is not analogous to either Applicant's likelihood that a problematic drilling operation will occur nor an indication of the severity of consequences should the problematic drilling operation occur. It is these types of risks that provide either a well planner or a drilling operation the most direct indication of problems, contrasted with merely providing a drilling operator, for example, with information that a hard formation strata lies in front of the drilling trajectory.

Other claims

Applicant respectfully asserts that Rao does not teach or suggest any "correlation of the well plan to a model of the earth." (Claims 2, 14 and 24.) The section cited in support of this

rejection, Rao col. 11: 20-64, is not supportive, instead being directed to use of acoustic signals to make resistivity determinations, using the resistivity measurements to provide error bands and a specific determination of pore pressure in front of the bit. Nowhere is a earth model mentioned; much less a correlation of a well plan with an earth model.


Applicant further respectfully asserts that Rao does not teach or suggest the iterative minimization of drilling hazard feature claimed in claims 4, 5, 13, and 23. Specifically, Applicant's steps of "adjusting at least one well plan parameter," "recalculating" the drilling hazard information, and then "repeating" the adjusting and recalculating steps until "a likelihood of encountering the at least one drilling hazard is minimized," for example. Although, Rao suggests adjustment of drilling equipment and parameters during drilling (Rao, col. 5:22-31 and col. 6:25-42), Rao does not suggest an iterative process to determine from a number of possible adjustments a best course of action or to minimize drilling hazards.

CONCLUSION

The Applicants believe this paper is fully responsive to each and every ground of rejection and objection cited by the Examiner, and respectfully request that the application proceed to grant.

Please charge any applicable fees, or apply any excess, to deposit account number 19-0610.

Respectfully submitted,


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10/3/04
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